GEO Joint Experiment for Crop Assessment and Monitoring (JECAM):

2014 Site Progress Report

JECAM Test Site Name: Canada – Red River Watershed

Team Leader and Members: Ian Jarvis, Andrew Davidson, Heather McNairn, Jarrett Powers, Bahram Daneshfar, Catherine Champagne, Jiali Shang.

Project Objectives

The original project objectives of the site have not changed. They are:

- Crop identification and Crop Area Estimation
  - 2013 growing season crop inventory maps were created (30m resolution) covering all Manitoba as a part of the Agriculture and Agri-Food Canada annual EO-based national crop inventory program.
  - Object-based crop inventory mapping with high resolution (5 m) EO data were tested resulting in very high classification accuracies. Such results indicated that this kind of crop mapping can replace a major part of the direct field observation at the location of the monitoring sampling framework.
  - Methods to accurately estimate the area of target crops in this study site are being tested and developed.
- Crop Condition/Stress
  - Nothing for 2013 – Leaf area index, biomass and cropscan were measured in 2012 and will be measured again in 2014.
- Soil Moisture
  - The site currently has nine automated in situ monitoring stations set up to capture larger scale variation in soil moisture to support calibration and validation of remotely sensed and modelled soil moisture data products. In the fall of 2013, three additional stations were installed in the north end of the site to assist in flood forecasting and prediction. The data from these stations is collected every 15 minutes and transmitted to a central server, where it undergoes a quality control filtering before it is released for distribution. This JECAM site is a calibration site for the SMAP mission and soil properties and soil moisture variability around these monitoring stations were well characterized during a six week intensive field campaign in 2012 (SMAPVEX 12).
- Crop Residue, Tillage and Crop Cover Mapping
  - Nothing for last year.

Site Description

- Location: Red River and Assiniboine River Basins, Manitoba (MB), Canada (see Figure 1).
- Topography: The majority of the soils in the study area are derived from lacustrine-based depositions and are very flat. The northern edge of the study area is more influenced by glacial-till deposition and has a lower relief ridge and swale topography.
- Soils: The majority of soils have a clay surface texture as a result of lacustrine deposits. Soils in the southwest region of the study area have sandier surface textures (sands-loamy sands) overlaying heavier clay deposits. Soils in the northern region are generally finer textured loams-clay loams with the occurrence of stones as a result of glacial-till deposits.

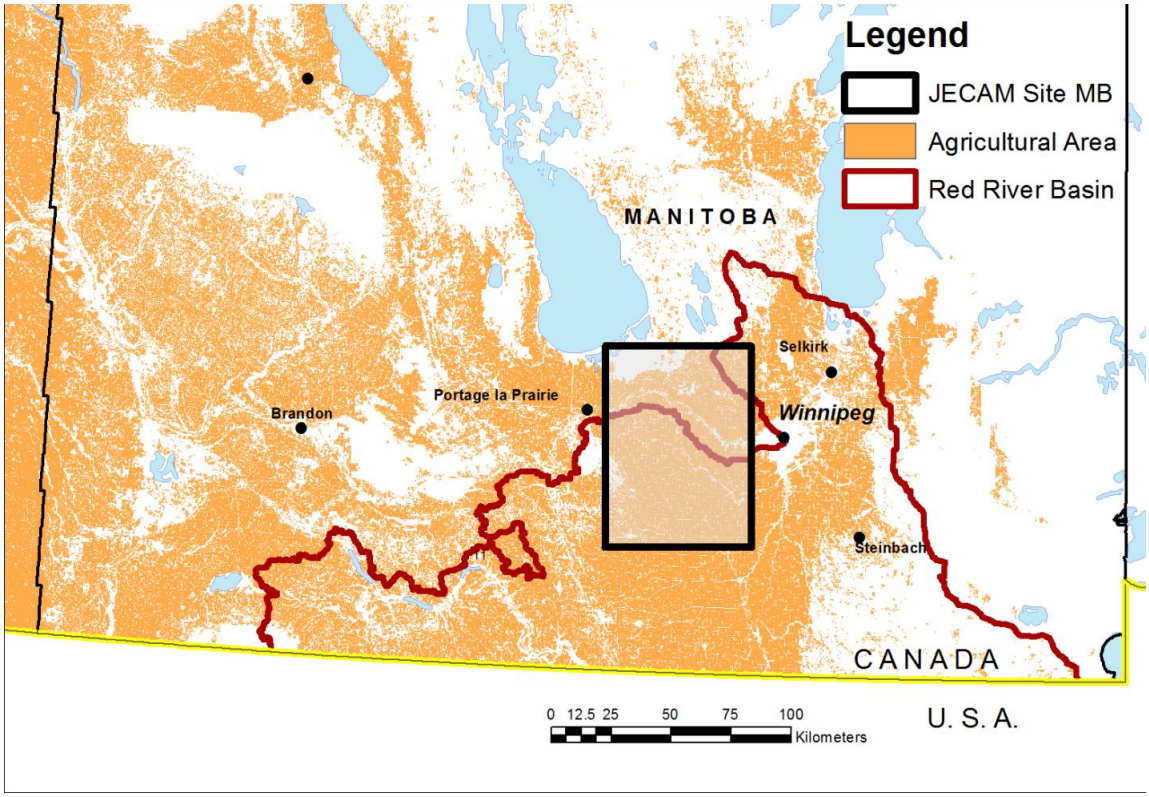

Figure 1: Location of the JECAM Monitoring Site in Southern Manitoba, Canada

- Drainage class/irrigation: The majority of the soils are imperfect to poorly drained. A large network of surface drains is in place to allow the production of annual crops. A limited amount of irrigation exists in the area near Portage la Prairie and Carmen on lands devoted to the production of potatoes and high-value horticultural crops. Tile drainage is installed on a small percentage of land around Carmen on imperfectly drained soils that are used for high value crop production.
- Crop calendar: Late April – early June (seeding), August – early October (harvest).
- Field size : Quarter Section - 64 hectares (160 acres).

- Climate and weather: The study area falls into the Humid Continental climate zone with cold winters and warm summers. Precipitation is distributed throughout the year with the majority of precipitation falling in the spring and summer months.
- Agricultural Crops used: Land is primarily used for the production of annual crops. Primary crops include: wheat, oats, canola, soybeans, corn. Potato production and other horticultural crops are produced near Carmen and Portage la Prairie. Conventional and minimum tillage systems are used for most annual crop production. The more marginal land in the northern areas is used for forage and pasture production.

Figure 2: Example of the General Morphology and Landscape of the JECAM Monitoring Site in Manitoba, Canada

EO Data Received/Used

Landsat 8, RADARSAT-2, RapidEye were used for 1-3 time intervals during the growing season of 2013.

In situ Data

Presently there are 12 in situ soil moisture monitoring stations in the Red River basin site as indicated in Figure 3. Crop types of 4018 fields covering all fields of 105 sections within the area covering the monitoring site in MB were recorded for developing methodologies to estimate crop areas very accurately (Figure 5).

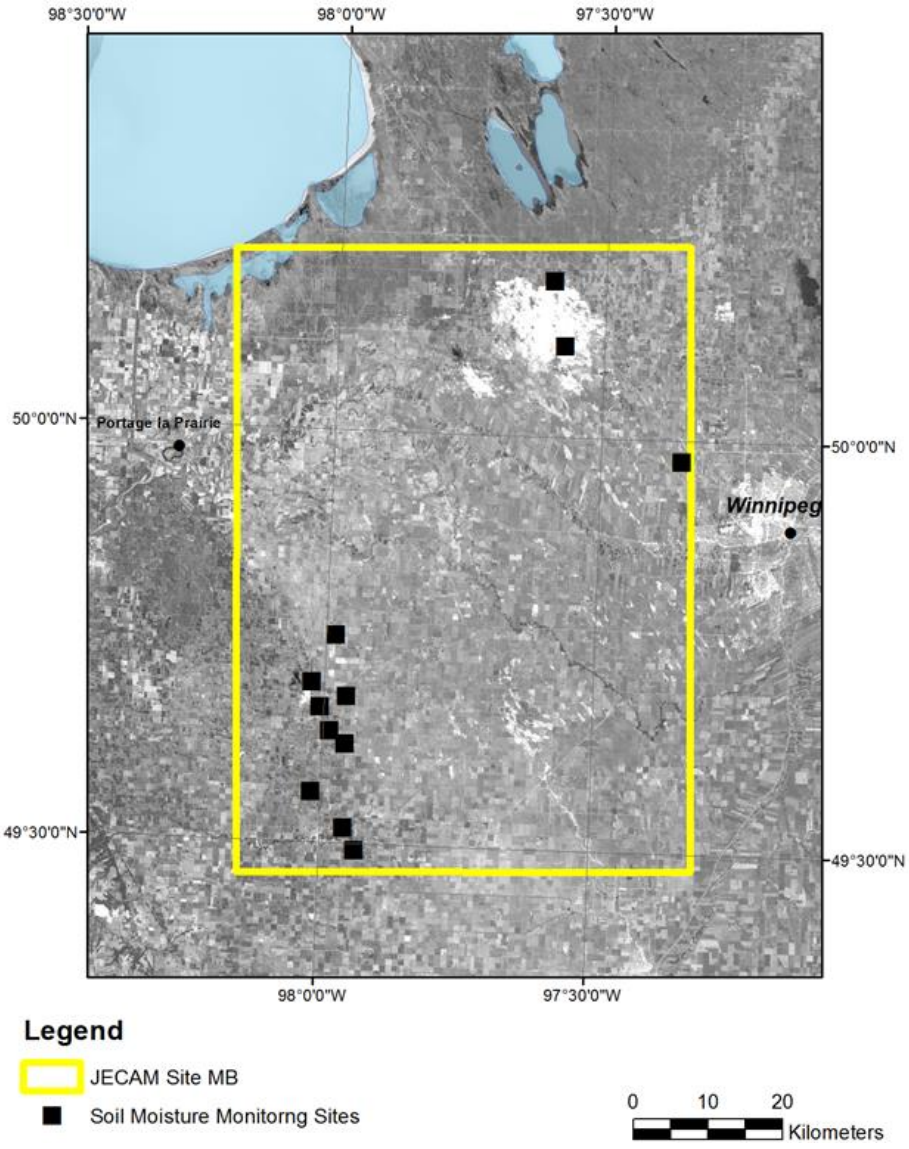

Figure 3: Location of the 12 In situ Soil Moisture Monitoring Stations within the JECAM Monitoring Site in Southern Manitoba, Canada

Figure 4: Photos of Station 8 of the In situ Soil Moisture Monitoring Network within the Red River Basin

Results

A crop types map (30 m resolution) was created for the whole area including the JECAM monitoring site (Figure 6) for 2013 growing season. Methods for accurate crop area estimation based on the annual crop inventory and crop types identified at the locations of the sampling framework of the monitoring sections are being developed.

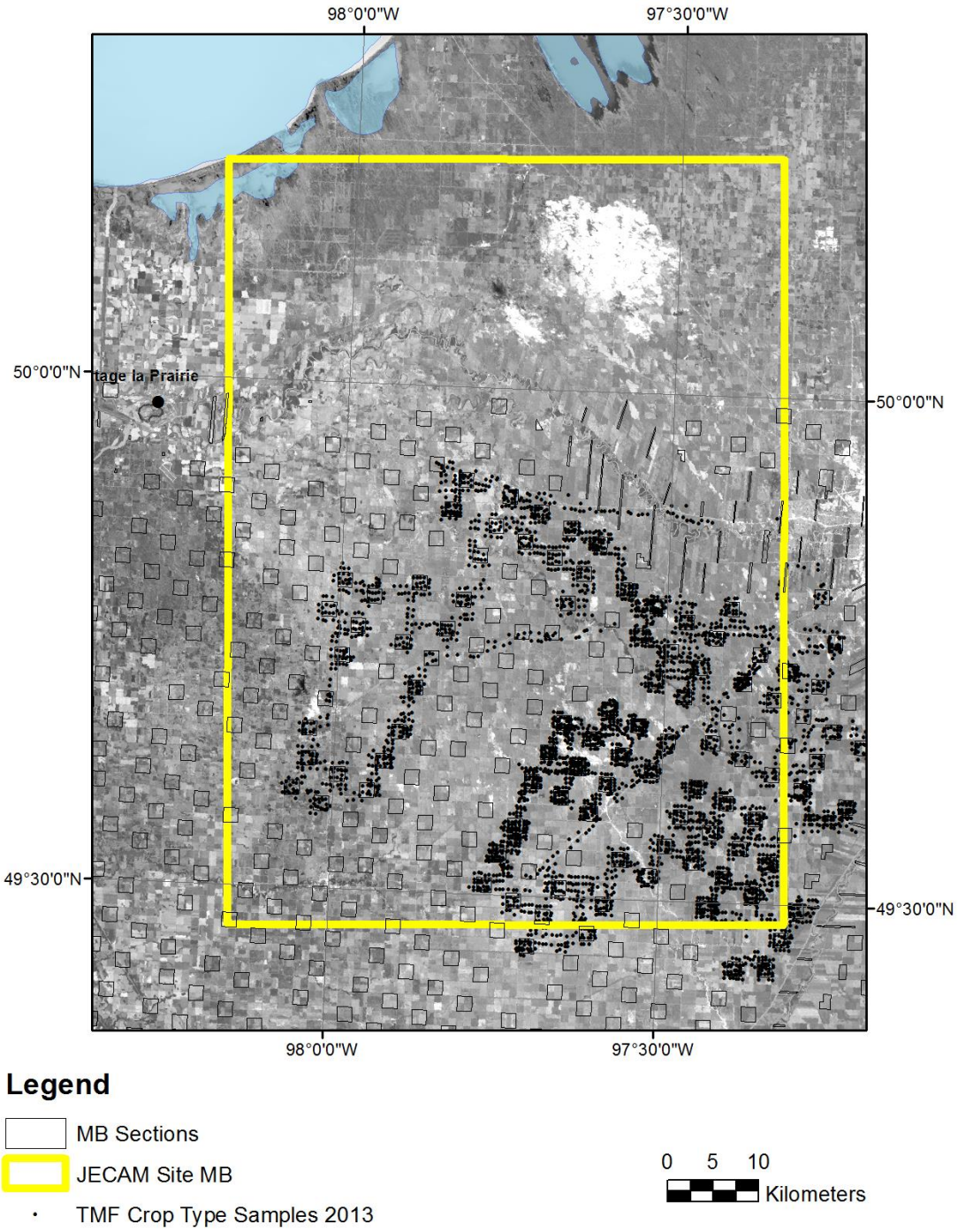

Figure 5: Crop Type Sampling at 4018 locations within Fields in the JECAM Monitoring Site in Southern Manitoba

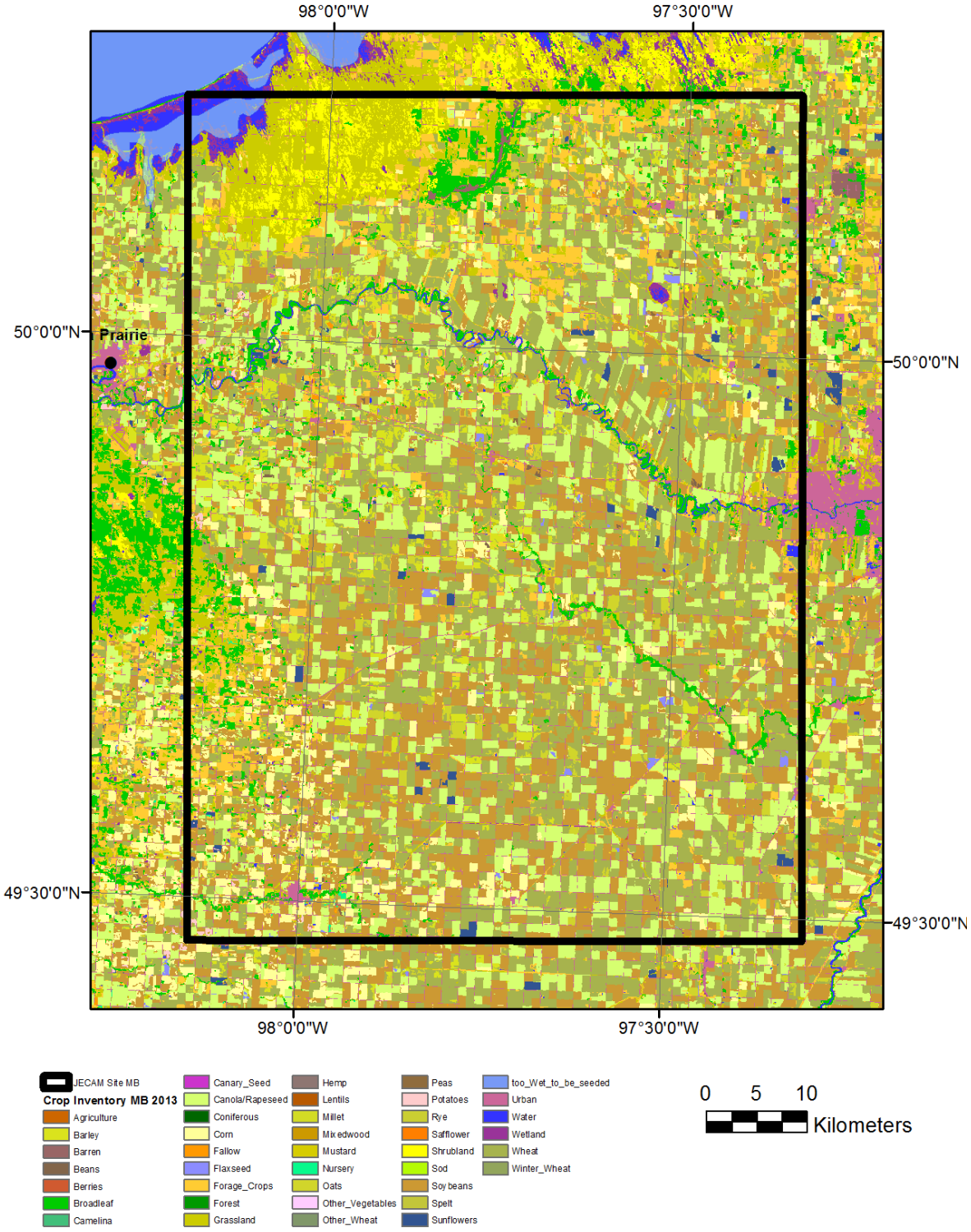

Figure 6: Crop Type Sampling at 4018 Locations within Fields in the JECAM Monitoring Site in Southern Manitoba

Plans for Next Growing Season

The EO-based 2014 crop inventory map (30 m resolution) will be created for the JECAM monitoring area. The accuracy of crop classes is estimated to be around 85%. Field work will be done to record crop types for all fields within some of the monitoring sections located in the JECAM monitoring area (Figure 5). Results will be applied to develop methods for very accurate crop area estimations.

Crop conditions will be monitored at several time intervals in an area south of the JECAM monitoring site (Figure 1). Methods to derived crop condition from radar and optical satellites will be developed.

Soil moisture mapping from active and passive microwave is being piloted over this site due to the high quality soil moisture validation available.

Publications

Roy, S. 2014. Simulation of Spatial and Temporal Variability of Soil Moisture Using the Simultaneous Heat And Water (SHAW) Model: Applications to Passive Microwave Remote Sensing, Graduate Thesis, University of Guelph, Department of Geography.

Rowlandson, T. L., A. A. Berg, P. R. Bullock, E. R. Ojo, H. McNairn, G. Wiseman, and M. H. Cosh, 2013: Evaluation of several calibration procedures for a portable soil moisture sensor. Journal of Hydrology, 498, 335-344.
